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IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Applicant: Paul A. Farrar

Title: CONDUCTIVE STRUCTURES IN INTEGRATED CIRCUITS

Docket No.: 303.557US1

Serial No.: 09/259,849

Filed: March 1, 1999

Due Date: September 13, 2006

Examiner: DiLinh Nguyen

Group Art Unit: 2814

MS Appeal Brief - Patents

Commissioner for Patents

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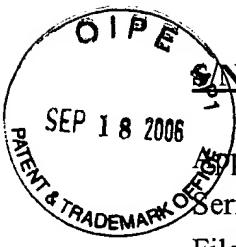
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PATENT

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REPLY BRIEF UNDER 37 CFR § 41.41

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This Reply is presented in response to the Examiner's Answer, (hereinafter the "Answer") dated July 13, 2006, which was sent in answer to Appellant's Appeal Brief, filed on April 13, 2006. Appellant's Appeal Brief was filed in response to the rejection of claims 1-7, 12-44, 50-77 and 186-189 of the above-identified application.

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Argument

The Appellant has reviewed the Answer, and believes the statements in the original Appeal Brief remain accurate and compelling. In responding to the Answer, the Appellant wishes to further clarify certain points of distinction between the pending claims and the cited references in response to newly presented comments. The corresponding pages of the Answer will be used to reference each of these points.

In addition, Appellant maintains each and every argument submitted in Appellant's pending Appeal Brief, and respectfully submits that each of the arguments are proper and valid in view of all of the statements made in the Answer. Therefore, any lack of reference in this Reply Brief to a particular argument in the pending Appeal Brief is not to be construed as an admission that the Appellant agrees with any of the statements in the Answer (Examiner's Answer). Appellant asks that the statements made in Appellant's pending Appeal Brief be considered in full, in addition to the statements included with this Reply Brief.

Reply to Examiner's Answer (10) Response to Argument

As stated in Appellant's Appeal Brief, the proposed combination of Havemann et al. and Brown et al., as used in the 35 U.S.C. 103(a) rejection of claims 1-7, 12-17, 19-21, 23-25, 27-32, 34-36, 38-41. 56-77, and 186-189, fails to teach or suggest all of the claimed subject matter included in each of these claims. As further noted on page 15 of Appellant's Appeal Brief, the Final Office Action *admits in several places* that Havemann et al. *does not disclose* removing the barrier layer and the seed layer from selected areas of the insulation, as included in one or more of claims 1-7, 12-17, 19-21, 23-25, 27-32, 34-36, 38-41. 56-77, and 186-189. Therefore, Havemann et al. fails to disclose, "removing the barrier layer and seed layer from selected areas of the insulator, leaving a seed area; . . . wherein the selected areas are directly on a top surface of the insulator," as recited for example in claim 1.

However, the Answer on pages 3-4 now appears to be attempting to argue that Havemann et al. ". . . teaches the claim limitation,' wherein the selected areas are directly on a top surface of the insulator.'"¹ as recited for example in claim 1 of Appellant's application. In contrast, the very statements made on page 3 of the Answer provide the contradiction to the arguments proposed by the Answer, and are the very arguments Appellant has consistently made as to why Havemann et al. fails to disclose, "wherein the selected areas are directly on a top surface of the insulator." For example, on page 3 the Answer states, "In figure 1h, Havemann discloses a method of **forming a conductive layer 122** (col. 3, lines 14-17) over a planarized surface 120 (col. 2, lines 45-47)." (Emphasis added). Further, the Answer on page 3 also states, "Figure 1f shows the barrier layer 150 and seed layers 152 are deposited on the surface area of the layer 122." Thus, these very statements as made in the Answer indicate that Havemann et al. discloses the barrier layer and the seed layer are deposited on the surface of a *conductive layer*, and thus fails to teach or suggest "wherein the selected areas are directly on a top surface of the insulator."

Because Havemann et al. discloses a conductive layer 122 over a planarized surface, Havemann et al. fails to disclose, "wherein the selected areas are directly on a top surface of the insulator," as recited for example in claim 1 of Appellant's application. (Emphasis added). Further, claim 1 also requires, "depositing a barrier layer on the insulator." As noted above, Havemann et al. discloses depositing the barrier layer on conductive layer 122, not an insulating

¹ See the Answer at page 3.

layer. Therefore, Havemann et al. fails to teach or suggest depositing a barrier layer on the insulator, and also fails to teach or suggest removing the barrier layer and the seed layer from selected areas *of the insulator*, wherein the selected areas are directly on a top surface of the insulator, all as included in for example claim 1 of Appellant's application.

For at least the reasons stated on pages 14-20 of Appellant's Appeal Brief, Appellant maintains the position that Havemann et al. fails to teach or suggest all of the subject matter induced in claims 1-7, 12-17, 19-21, 23-25, 27-32, 34-36, 38-41, 56-77, and 186-189.

On page 4 the Answer states, "The same response applies to Brown." However, as noted on pages 16-17 of Appellant's Appeal Brief with regards to Brown et al.,

As underlined above, Brown et al. clearly discloses barrier and seed layers shown in Fig. 5F are deposited directly on a **conductive layer 500**, which separates the dielectric layer 505 from the barrier and seed layer. Brown et al. goes on to describe that this particular arrangement is used to "make a conductive path through the barrier metal and copper seed layers 525A and 525B in the opening 520 and through the conductive layer 500." Thus, Brown et al. clearly fails to disclose for example, "wherein the selected areas are directly on a top surface of the insulator," as recited in claim 1. (Emphasis added). Therefore, Fig. 5 and the disclosure in Brown et al. contradict the arguments presented in Final Office Action. (Emphasis added).

Thus, Brown et al. discloses a barrier and a seed layer deposited directly on a conductive layer, not an insulating layer. In contrast to the disclosure in Brown et al., the Answer on page 4 with respect to the disclosure of Brown et al. states, "The barrier and seed layers then removed from the top surface of the insulator layer." This statement is directly contradicted by the disclosure of Brown et al., for example in the portion of the disclosure from Brown et al. as quoted on page 15 of Appellant's Appeal Brief.² Therefore, the statements on page 4 of the

² The referred to portion of Brown et al. at column 8, line 54 through column 9, line 2 as quoted in Appellant's Appeal Brief recites:

As shown in FIG. 5F, the masking layer 515, along with portions of the barrier metal and copper seed layers 525A and 525B overlying the masking layer 515, may be removed. For example, a masking layer 515 formed of photoresist may be removed by being stripped off in a solvent bath. Alternatively, the masking layer 515 may be removed before the barrier metal and copper seed layers 525A and 525B are formed (for example, by being deposited) to make a conductive path through the barrier metal and copper seed layers 525A and 525B in the opening 520 and through the conductive layer 500. The barrier metal and copper

Answer, for example - "The barrier and seed layers then removed from the top surface of the insulator layer" - are directly contradicted by the disclosure of Brown et al. Because the statements made on page 4 of the Answer regarding the purported disclosure of Brown et al. are in contrast to the actual disclosure provided in the written description in Brown et al., the Final Office Action, and now the Answer, fail to show how the disclosure of Brown et al. teaches or suggests the claimed subject matter as recited for example in claim 1, including,

depositing a barrier layer **on the insulator**;
depositing a seed layer directly on the barrier layer;
removing the barrier layer and seed layer from selected areas **of the insulator**, leaving a seed area; and
depositing a conductor on the seed area by a selective deposition process after removing the barrier layer and seed layer from selected areas of the insulator;
wherein the selected areas are directly on a top surface of the insulator.

(Emphasis added).

Appellant therefore maintains the position that Brown et al., even if considered in combination with Havemann et al., fails to teach or suggest all of the claimed subject matter included in claims 1-7, 12-17, 19-21, 23-25, 27-32, 34-36, 38-41, 56-77, and 186-189.

Further, on page 4 with respect to claim 13, the Answer states,

In regard to claim 13, the claim recites the depth of the trench between fifty and 1000 angstroms. This is a large range and not a critical feature of the instant invention since the instant specification does not disclose the advantage of the depth or because the Appellant has not disclosed that this depth provides an advantage, is used for a particular purpose, or solves a stated problem.

While Appellant does not necessarily agree with these statements, these statements fail to address the Final Office Action's failure to establish a *prima facie* case of obviousness with respect to claim 13. The Office Action fails to show a teaching or suggestion in either Havemann et al. or Brown et al. of the subject matter as recited in claim 13, and also fails to provide any evidence as to how the subject matter include in claim 13 would have been obvious

seed layers 525A and 525B shown in FIG. 5D would then be deposited directly on the conductive layer 500, since the masking layer 515 would have been removed before the barrier metal and copper seed layers 525A and 525B were deposited. (Emphasis added).

to those of ordinary skill in the art. Without such a showing, the Final Office Action fails to establish a *prima facie* case of obviousness in rejecting claim 13, regardless of whether the "range" of claim 13 is large, or whether the subject matter of claim 13 is "a critical feature of the instant invention" as purported in the Answer.

Still further, on page 5 the Answer, in response to Appellant's arguments against forming the proposed combination of Havemann et al. and Brown et al. states,

The fact that different **art-recognized equivalent** connection means present in the mentioned references does not teach away from utilizing the metal of Brown in the Havemann reference.

However, these statements are contradicted by the disclosure in Brown et al. For example, the Appellant's Appeal Brief on pages 22-23 states,

A careful review of the cited portion of Brown et al.³ reveals that these metals present various problems (such as corrosion in silver) and constraints (such as cost) when being used in the formation of semiconductor devices, and therefore present various tradeoffs with respect to conductivity, cost, and difficulty in manufacturability. Thus, Brown et al. fails to disclose that these metals are alternatives to one another as suggested in the Final Office Action. In fact, Brown et al. teaches away from these materials as alternatives to one another in particular applications based on one or more of the characteristics discussed in the cited portion of the specification of Brown et al.

Thus, Brown et al. discuss various problems and constraints when using alternative material in the formation of semiconductor devices, and so Brown et al. teaches away from the use of one or more of these materials as alternatives in particular applications based on these characteristics. The proposition that these material are "alternatives" is not supported by, and is contrary to, the disclosure of the cited references. Brown et al. actually discourages certain applications of these materials based on the particular application, and therefore the disclosure in Brown et al. does not support forming the proposed combination of Havemann et al. with Brown et al. as suggested by the Final Office Action. (Emphasis in original).

Thus, Brown et al. describes different metal as having various problems and constraints as used in the formation of semiconductor devices, depending on the metal used. The Answer

³ See e.g. Brown et al. at column 1, lines 20-46.

fails to point out in either Havemann et al. or Brown et al. a disclosure of these metals as being "art-recognized equivalent." In fact, Brown et al. describes just the opposite, wherein for example silver presents a corrosion problem not discussed in conjunction with other metals, such as gold. Because Brown et al. discusses these metals as having different problems and constraints, the metals are not disclosed in Brown et al. as "alternatives," and are not disclosed as "art-recognized equivalent," as purported in the Final Office Action and in the Answer. Thus, these statements made in the Answer in support of forming the proposed combination of Havemann et al. and Brown et al. are contradicted by the disclosure of Brown et al., the very document the Final Office Action relies on as describing these other metals such as gold and silver.

The Answer includes additional statements made in an attempt to meet the requirements for forming the proposed combination of Havemann et al. and Brown et al. and for which no support in Havemann et al. or in Brown et al. is cited, and for which no other evidence to support the statements is provided. For example, the Answer on pages 5-6 states,

In this case, silver is a substituted metal and may be used to replace copper or aluminum since silver provides a better strength and can sustain higher temperature.

However, the Answer fails to cite to any portion of the disclosure in either Havemann et al. or in Brown et al., or to any other evidence, to support these statements. The Answer merely states on page 6, "This is also well known to one of ordinary skill in the art." Statements to this effect, without any document or evidence to support the statements, fail to meet the requirements for establishing a *prima facie* case of obviousness with respect to claims such as claim 19 that include silver.

Still further, the Final Office Action, as argued on page 20 of Appellant's Appeal Brief, makes several statements related to the alleged disclosure of Havemann et al. and Brown et al. in an attempt to meet the requirements for forming the proposed combination of Havemann et al., and Brown et al. that, for at least the reasons discussed on pages 20-23 of Appellant's Appeal Brief, are not supported by the disclosures of either Havemann et al. or Brown et al. In response to these arguments in the Appellant's Appeal Brief, the Answer on page 6 merely states,

In this case, Brown indeed teaches that the selectively deposit a layer to a selective area decreased the cost of raw materials (see Brown's col. 16, lines 42-60).

However, as noted on pages 20-21 of Appellant's Appeal Brief, the Final Office Action proposes that the cost savings, and thus the motivation to combine Havemann et al. with Brown et al., relates "to remove the barrier layer and the seed layer from selected areas and to deposit the conductor . . ." As argued in Appellant's Appeal Brief, any savings discussed in Brown et al. relate to the selective deposition of the copper layer, and are not related "to remove the barrier layer and the seed layer form selected areas" as purported in the Final Office Action.

In addition, as argued on pages 21-22 of Appellant's Appeal Brief, Havemann et al. is concerned with CMP processes having manufacturability problems, and discloses removing copper and TiN outside the interconnect trenches by CMP as a way of planarizing any bumpiness in the plated copper. Thus, rather than reducing cost, Havemann et al. discloses the deposition of copper and TiN outside the interconnect trenches, and the further removal of the copper and TiN through planarization of copper in order to reduce CMP manufacturability problems as a solution to the manufacturability problems. The statements in the Answer that Brown et al. teaches selective deposition of a layer to decrease costs appear to be contrary to, and would in fact destroy the stated purpose of the processes described in Havemann et al. because Havemann et al. discloses depositing excess copper outside the trench, and then planarizing the copper to remove bumpiness in the plated copper. Thus, the basis provided in the Answer as the grounds for a suggestion of a motivating to combine Brown et al. with Havemann et al., i.e. selectively depositing a layer to decrease the cost of raw material, is contradicted by, and destroys the stated purpose of, the processes described by Havemann et al. For at least these reasons, the Final Office Action, and now the Answer, fail to meet the requirements for showing the desirability⁴ of the proposed combination of Havemann et al. and Brown et al.

For at least the reasons stated above, and the arguments presented on pages 20-23 of Appellant's Appeal Brief, Appellant maintains that the Final Office Action, and now the Answer, fail to state a proper basis for forming the proposed combination of Havemann et al. with Brown

⁴ Further yet, the fact that references can be combined or modified does not render the resultant combination obvious unless the prior art also suggests the desirability of the combination. *In re Mills*, 916 F.2d 680, 16 USPQ2d 1430 (Fed. Cir. 1990); MPEP § 2143.01.

et al., and so fail to state a *prima facie* case of obviousness with respect to claims 1-7, 12-17, 19-21, 23-25, 27-32, 34-36, 38-41, 56-77, and 186-189.

With respect to the failure of the Final Office Action to provide a proper basis for forming the proposed combination of Havemann et al., Brown et al., and Ting et al., the Answer on pages 6-7 states,

The Appellant further submits that there is no motivation for the combination of Havemann, Brown, and Ting in the rejecting of claims 18, 22, 26, 33, and 37.

However and in contrast, Appellant's Appeal Brief on page 24 actually states,

In addition, the Final Office Action does not provide any *additional motivation* for combining *Havemann et al. with Brown et al.* with regards to claims 18, 22, 26, 33, 37, 42-44, and 50-55. (Emphasis added).

In other words, the Final Office Action relies on the arguments presented earlier in the Final Office Action for a suggestion of a motivation to combine Havemann et al. with Brown et al., and fails to provide any *additional motivation* for forming the proposed combination of Havemann et al. and Brown et al. in the rejection of claims 18, 22, 26, 33, 37, 42-44, and 50-55 based on the proposed combination of Havemann et al., Brown et al., and Ting et al. By failing to meet the requirements for forming the proposed combination of Havemann et al. and Brown et al., and by failing to provide any additional motive for combining Havemann et al. with Brown et al. in attempting to form the proposed combination of Havemann et al., Brown et al., and Ting et al., the Final Office Action, and now the Answer, fail to meet the requirements for forming the proposed combination of Havemann et al., Brown et al., and Ting et al. By failing to meet these requirements, the Final Office Action, and now the Answer, fail to state a *prima facie* case of obviousness with respect to claims 18, 22, 26, 33, 37, 42-44, and 50-55.

In addition, the Answer on page 7 states,

... the Examiner provides that it would have been obvious to one of ordinary skill in the art at the time of the invention was made to use an aluminum-copper seed layer instead of a copper seed layer and to form a conductor comprising any of gold, silver, aluminum or copper since it has been held to be within the general skill of an artisan in the art to select a known conductive material on the basis of suitability for the intended use as a matter of

obvious in a certain design. **These materials indeed function the same as providing electrical connection.** (Emphasis added).

Appellant disputes the validity of these statements, wherein for example Brown et al. as discussed above, specifically discloses some of the various problems and constraints associated with the use of different metals as conductors. Thus, the disclosure in Brown et al. contradicts the statements on page 7 of the Answer that "these material indeed function *the same as* providing electrical connection." (Emphasis added). Therefore, the statements provided in the Answer are contradicted by the disclosure of Brown et al., and thus fail to remedy the deficiency in the Final Office Action of providing a suggestion of a motivation to combine Haman et al., Brown et al., and Ting et al.

Further yet, the fact that references can be combined or modified does not render the resultant combination obvious unless the prior art also suggests the desirability of the combination. *In re Mills*, 916 F.2d 680, 16 USPQ2d 1430 (Fed. Cir. 1990); MPEP § 2143.01. The Final Office Action, and now the Answer, fail to show the desirability of forming the proposed addition of the disclosure of Ting et al. to the proposed combination of Havemann et al. and Brown et al. Without this, Appellant maintains that the Final Office Action, and now the Answer, fail to meet the requirements for forming the proposed combination of Havemann et al., Brown et al., and Ting et al., and so fail to state a *prima facie* case of obviousness with respect to the rejection of claims 18, 22, 26, 33, 37, 42-44, and 50-55.

CONCLUSION

For the reasons stated above and in the Appellant's Appeal Brief, Appellant respectfully submits that claims 1-7, 12-17, 19-21, 23-25, 27-32, 34-36, 38-41, 56-77, and 186-189 were not properly rejected under 35 U.S.C. § 103(a) as being unpatentable over Havemann et al. (U.S. 6,358,849) in view of Brown et al. (U.S. 6,168,704). Further, claims 42-44 and 50-55 were not properly rejected under 35 U.S.C. § 103(a) as being unpatentable over Havemann et al. in view of Brown et al. and Ting et al. (U.S. 5,969,422). And further, claims 18, 22, 26, 33, and 37 were not properly rejected under 35 U.S.C. § 103(a) as being unpatentable over Havemann et al. in view of Brown et al. as applied to claims 1-7, 12-17, 19-21, 23-35, 27-32, 34-36, 38-41, 56-77 above, and further in view of Ting et al.

Reversal of the rejections and allowance of all pending claims is respectfully requested.

Respectfully submitted,

PAUL A. FARRAR

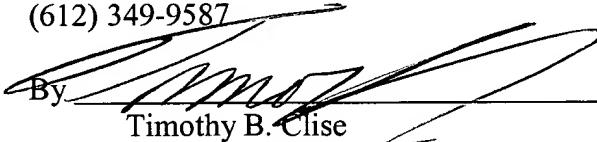
By his Representatives,

SCHWEGMAN, LUNDBERG, WOESSNER & KLUTH, P.A.
P.O. Box 2938
Minneapolis, MN 55402
(612) 349-9587

Date

13 Sept '06

By


Timothy B. Clise
Reg. No. 40,957

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Kate G
Name

Kate G
Signature